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Publication date:
2015

Document Version
Peer reviewed version

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Abstract

Process simulations are an effective design and optimization tool in conventional as well as micro injection molding (µIM). They can be applied to optimize and assist the design of the micro part, the mold, the micro cavity and the µIM process. Available simulation software is however developed for macroscopic plastic parts. By using the correct implementation and careful modelling though, it can also be applied to micro parts. In the present work, process simulations were applied to a microfluidic distributor and a microfluidic mixer of which features were in the 100 µm dimensional range. The meshing and the challenges of the two devices in the simulation software to obtain a proper simulation model were described. Focus of the investigation was on the filling pattern and the optimization of selected gate designs. Subsequently, the simulation results were used to find the most appropriate gate design with regard to moulding process window, polymer flow, and part quality. This finally led to an optimization of the design and the realization as actual steel mold. Additionally, the simulation results were critically discussed and possible improvements and limitations of the gained results and the deployed software are presented. Ultimately, the simulation results were validated by comparing the flow pattern behavior of the polymer flow predicted by the simulation with the actual flow front at different time steps. These were realized by molding short shots with the realized molds and were compared to the simulations at the global, i.e. part level, and at the local, i.e. feature level (see Figure 1).

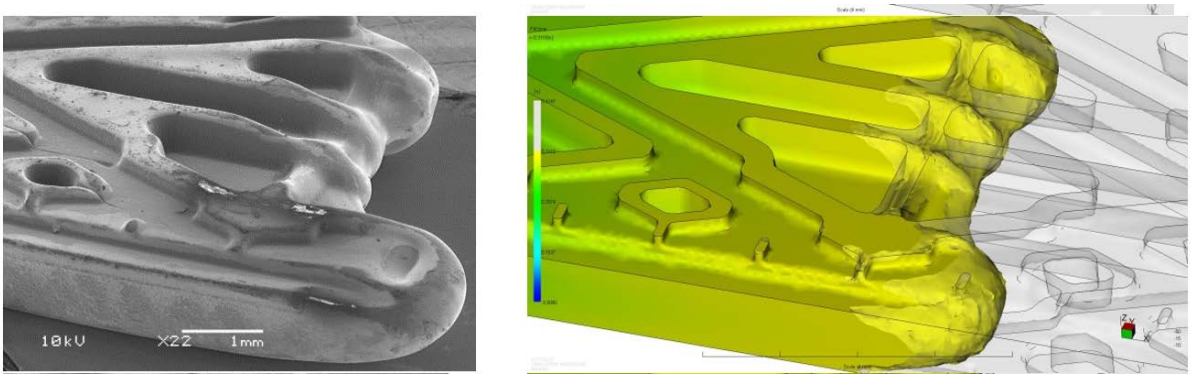

Figure 1: Comparison between actually molded and simulated plastic part during the filling phase.